The CM1022-CA is a professional protection IC for 2 cell Li-Ion/Polymer battery packs, it works constantly to monitor each cell's voltage, the current of charge or discharge to provide overcharge, over- discharge, discharge overcurrent, short circuit, charge overcurrent protections.

■ Features

1) High accuracy voltage detection

• Overcharge detection voltage	4.250 V	Accuracy ±25 mV
• Overcharge hysteresis voltage	0.200 V	Accuracy ±50 mV
• Over discharge detection voltage	2.500 V	Accuracy ±80 mV
• Over discharge hysteresis voltage	0.500 V	Accuracy ±100 mV

2) Three grades voltage detection of discharge overcurrent

• Discharge overcurrent 1	0.100 V	Accuracy ±15%
• Discharge overcurrent 2	0.200 V	Accuracy ±15%
• Short circuit	0.400 V	Accuracy ±15%
• Charge overcurrent detection	-0.100 V	Accuracy ±30%

3) Charge and load detect function

4) Charge and discharge over temperature protection

5) Open-wire Detection

6) NTC resistance disconnection protection function

7) Low current consumption

• Normal mode	12 μA (typ) (Ta = +25°C)
• Power-down mode	5.0 μA (typ) (Ta = +25°C)

8) RoHS、PB-free、HF

■ Applications

- Power tools
- Sweeping robot
- UPS

■ Packages

- MSOP10

■ Block Diagram

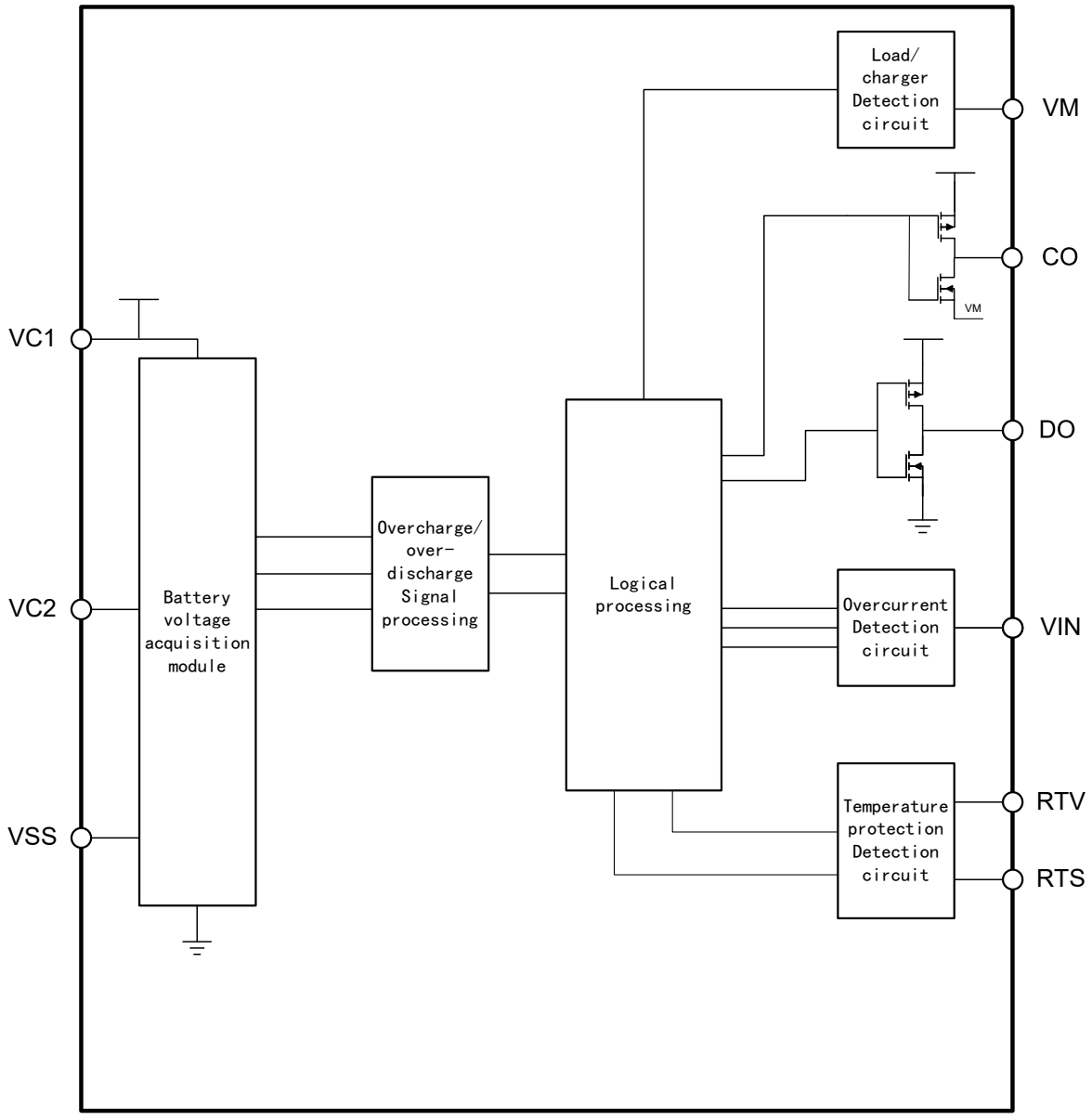


Figure 1

■ Pin Configurations

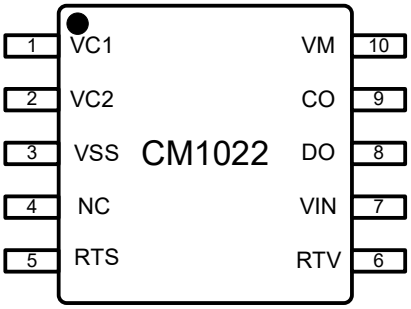


Figure 2

PIN	Symbol	Description
1	VC1	Power supply, Cell1 positive input
2	VC2	Cell1 negative input, Cell2 positive input
3	VSS	Ground pin of the IC, Cell2 negative input
4	NC	Empty pin, no electrical connection
5	RTS	Cell temperature detection
6	RTV	Temperature protection reference
7	VIN	Charge and Discharge overcurrent Voltage detection terminal
8	DO	Discharge power mosfet control terminal
9	CO	Charge power mosfet control terminal
10	VM	Detecting load or charger

Table 1

■ Product Name Structure

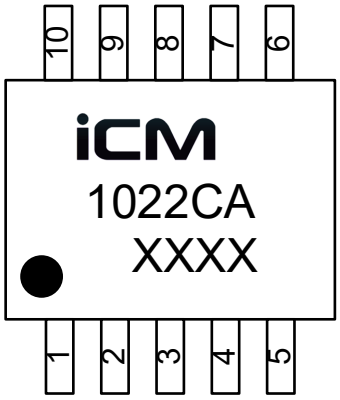
CM1022-XX

Version number: such as A, B

Code，A ~ Z

Product Series

■ Marking



The first line: LOGO
The second line: Product code
The third line: Lot number

Figure 3

■ Products list

Part NO	Overcharge protection voltage [V_{OC}]	Overcharge release voltage [V_{OCR}]	Over-discharge protection voltage [V_{OD}]	Over-discharge release voltage [V_{ODR}]	Excess current1 detection voltage [V_{EC1}]	Excess current2 detection voltage [V_{EC2}]	Short circuit detection voltage [V_{SHORT}]	Charge overcurrent detection voltage [V_{CHA}]
CM1022-CA	4.250 V	4.050 V	2.500 V	3.000 V	0.100 V	0.200 V	0.400 V	-0.100 V

Table 2

■ Absolute Maximum Ratings

(Unless otherwise specified: Ta = +25°C)

Item	Symbol	Description	Ratings	Unit
Power supply voltage	VC1	VC1	VSS-0.3 ~ VSS+20	V
Input pin voltage 0	V_{CELL}	VC1-VC2, VC2-VSS	-0.3 ~ 6.5	V
Input pin voltage 1	V_{IN1}	RTS, RTV, VIN	VSS-0.3 ~ VSS+6.5	V
Input pin voltage 2	V_{IN2}	VM	VCC-20 ~ VCC+0.3	V
CO output voltage	V_{CO}	CO	VCC-20 ~ VCC+0.3	V
DO output voltage	V_{DO}	DO	VCC-0.3 ~ VCC+0.3	°C
Operating temperature	T_{OPR}	–	-40 ~ +85	°C
Storage temperature	T_{STG}	–	-55 ~ +125	°C

Table 3

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded in any conditions.

■ Electrical Characteristics

(Unless otherwise specified : Ta = +25°C)

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating consumption		I_{VC1}	V1=V2=3.5V VM=0V	-	12	20	μA
Sleeping consumption		I_{STB}	V1=V2=2.0, VM=4V	-	5	6.5	μA
Overcharge	Protection threshold	V_{OC}	V1=3.5V V2=3.5 → 4.4V	4.225	4.250	4.275	V
	Release threshold	V_{OCR}	V1=3.5V V2=4.4 → 3.5V	4.000	4.050	4.100	V
	Protection delay time	T_{OC}	V1=3.5V V2=3.5 → 4.4V	0.5	1.0	1.5	s
Over-discharge	Protection threshold	V_{OD}	V1=3.5V V2=3.5 → 2.0V	2.420	2.500	2.580	V
	Release threshold	V_{ODR}	V1=3.5V V2=2.0 → 3.5V	2.900	3.000	3.100	V
	Protection delay time	T_{OD}	V1=3.5V V2=3.5 → 2.0V	0.5	1.0	1.5	s
Discharge overcurrent 1	Protection threshold	V_{EC1}	V1=V2=3.5V VIN=0 → 0.12V	0.085	0.100	0.115	V
	Protection delay time	T_{EC1}	V1=V2=3.5V VIN=0 → 0.12V	0.5	1.0	1.5	s
Discharge overcurrent 2	Protection threshold	V_{EC2}	V1=V2=3.5V VIN=0 → 0.3V	0.170	0.200	0.230	V
	Protection delay time	T_{EC2}	V1=V2=3.5V VIN=0 → 0.3V	50	100	150	ms
Short circuit	Protection threshold	V_{SHORT}	V1=V2=3.5V VIN=0 → 0.8V	0.340	0.400	0.460	V
	Protection delay time	T_{SHORT}	V1=V2=3.5V VIN=0 → 0.8V	100	300	500	μs
Discharge overcurrent release delay		T_{ECR}	V1=V2=3.5V VIN=0.8 → 0V, VM=VC1 → 0V	24	48	72	ms
Charge overcurrent	Protection threshold	V_{CHA}	V1=V2=3.5V VIN=0→ -0.5V	-0.070	-0.100	-0.130	V
	Protection delay time	T_{CHA}	V1=V2=3.5V VIN=0→ -0.5V	10	20	30	ms
	Release delay time	T_{CHAR}	V1=V2=3.5V VIN=-0.5V→0V	24	48	72	ms
Open-wire	Protection delay time	T_{OW}	-	10	20	30	ms
	Release delay time	T_{OWR}	-	24	48	72	ms
Temperature protection	Charging high temperature protection	TCH	V1=V2=3.5V RTS=100K→10K	TCH-5	TCH	TCH+5	°C

	temperature						
	Charging high temperature recovery temperature	TCHR	V1=V2=3.5V RTS=10K→100K	TCHR-5	TCHR	TCHR+5	°C
	Dis-charging high temperature protection temperature	TDH	V1=V2=3.5V RTS=100K→10K	TDH-5	TDH	TDH+5	°C
	Dis-charging high temperature recovery temperature	TDHR	V1=V2=3.5V RTS=10K→100K	TDHR-5	TDHR	TDHR+5	°C
	Charging high temperature protection delay time	DL_TCH	V1=V2=3.5V RTS=100K→10K	0.5	1.0	1.5	s
	Charging high temperature release delay time	DL_CHR	V1=V2=3.5V RTS=10K→100K	64	128	192	ms
	Discharging high temperature protection delay time	DL_DH	V1=V2=3.5V RTS=100K→10K	0.5	1.0	1.5	s
	Discharging high temperature release delay time	DL_DHR	V1=V2=3.5V RTS=10K→100K	64	128	192	ms
Discharge status detection voltage		Vsts	V1=V2=3.5V VIN=0→10mV	1.0	4.0	7.0	mV

Table 4

■ Function Description

1. Overcharging status

When the voltage of any battery rises above V_{OC} and exceeds T_{OC} for time, the output of the CO terminal will be reversed, and the charging control MOS tube will be turned off to stop charging. This is called an overcharge state. The voltage of all batteries drops below the overcharge release voltage V_{OCR} and continues to exceed T_{OCR} for time, the overcharge status is released, and the normal status is restored. If the load is connected at this time, when the voltage of all batteries drops below the overcharge protection voltage V_{OC}, the overcharge state is released and the normal state is restored. This function is called the load detection function.

2. Over discharging state

When the voltage of any battery drops below V_{OD} and exceeds T_{OD} for time, the output of the DO terminal will be reversed, the discharge control MOS tube will be turned off, and the discharge will stop. This is called an over-discharge state. When the voltage of all batteries rises above the over-discharge release voltage V_{ODR} and continues to exceed T_{ODR} for a period of time, the over-discharge status is released, and the normal status is restored. If the charger is connected ($VM<V_{CHA}$) at this time, when the voltage of all batteries rises above the over-discharge protection voltage (V_{OD}), the over-discharge status is released and the normal status is restored. This function is called the charger detection function.

3. Discharging overcurrent state

When the battery is in a discharging state, the V_{IN} terminal voltage increases with the increase of the discharge current. When the V_{IN} terminal voltage is higher than V_{EC1} and continues to exceed T_{EC1} for a period of time, the chip considers that a discharge overcurrent 1 has occurred; when the VIN terminal voltage is higher than V_{EC2} If it exceeds T_{EC2} for a period of time, the chip considers that a discharge overcurrent 2 has occurred; when the V_{IN} terminal voltage is higher than V_{SHORT} and continues to exceed T_{SHORT} for a period of time, the chip considers a short circuit. After any one of the above three states occur, the output of the DO terminal will be reversed, the discharge control MOS tube will be turned off, and the discharge will stop. After entering the discharge overcurrent protection state, disconnect the load and VM<3.0V, the discharge overcurrent protection is released, and the normal state is restored.

4. Charging overcurrent state

In a battery under normal working conditions, during the charging process, if the V_{IN} terminal voltage is lower than the charge overcurrent protection voltage (V_{CHA}), and this state lasts for longer than the charge overcurrent protection delay T_{CHA}, the charge control MOS tube will be turned off. Stop charging, this state is called charging overcurrent state. After entering the charging overcurrent protection state, if the charger is disconnected and $VM>V_{CHA}$, the charging overcurrent state will be released and the normal state will be restored.

5. Temperature protection

During the charging and discharging process, the cell temperature is too high or too low will cause damage to the cell, so the thermistor R_{NTC} needs to be used to sense the temperature change, when it reaches the set protection temperature and

maintains it for a period of time, it will happen Temperature protection, the charging or discharging MOS tube is turned off, realizing the protection of the high and low temperature of the battery charging and discharging.

When the V_{INI} terminal is less than 4mV, the chip recognizes the charging state by default. If the detected temperature is higher than the charging high temperature protection temperature T_{CH} and the duration exceeds DL_TCH, the charging MOS tube will be turned off; the charging high temperature protection hysteresis temperature is 5°C.

When the V_{INI} terminal is greater than 4mV, the chip is recognized as a discharging state. If the detected temperature is higher than the discharge high temperature protection temperature TDH and the duration exceeds DL_TDH, the charge and discharge MOS tube will be turned off at the same time. The hysteresis temperature of the high-temperature discharge protection is 10°C.

The RTS connection resistance R_{NTC} selects a resistance with B value=3950 and a normal temperature of 100kΩ@25°C, and the RTV connection resistance R_T is used to set the high temperature protection temperature. The size of the R_T resistance is 3 times the resistance of the R_{NTC} resistance. The discharge high temperature protection temperature has a one-to-one correspondence with the charging high temperature protection. The specific settings are as follows:

TCH	TCHR	R_{NTC}	R_T	TDH	TDHR
40°C	35°C	53.01K	160K	59°C	49°C
45°C	39°C	43.48K	133K	65°C	54°C
50°C	45°C	35.88K	110K	70°C	59°C
55°C	49°C	29.78K	90.9K	76°C	65°C
60°C	54°C	24.86K	75K	82°C	71°C

Table 5

The CM1022-CA has the NTC disconnection protection function. If the RTV is connected to the resistor, but the NTC is disconnected, the chip will judge that the NTC is disconnected, and the output of the CO and DO terminals will be reversed; if the temperature protection function is not used, the R_{NTC} can be connected to Connect 100kΩ resistor to each RT.

The CM1022-CA has an optional function of charging low temperature protection. If you need this function product, please contact our FAE.

6. Open-Wired protection

In the normal state, if any one or more of the chip pins VC1 and VC2 are disconnected from the battery, the chip will detect that it is disconnected, and the CO and DO output levels will be forcibly reversed and turned off at the same time Charging and discharging MOS, charging and discharging are prohibited, this state is called disconnection protection state. When the disconnected connection is correctly connected again, the chip exits the disconnection protection state.

■ Application Circuits

1. Charge & discharge circuit sharing

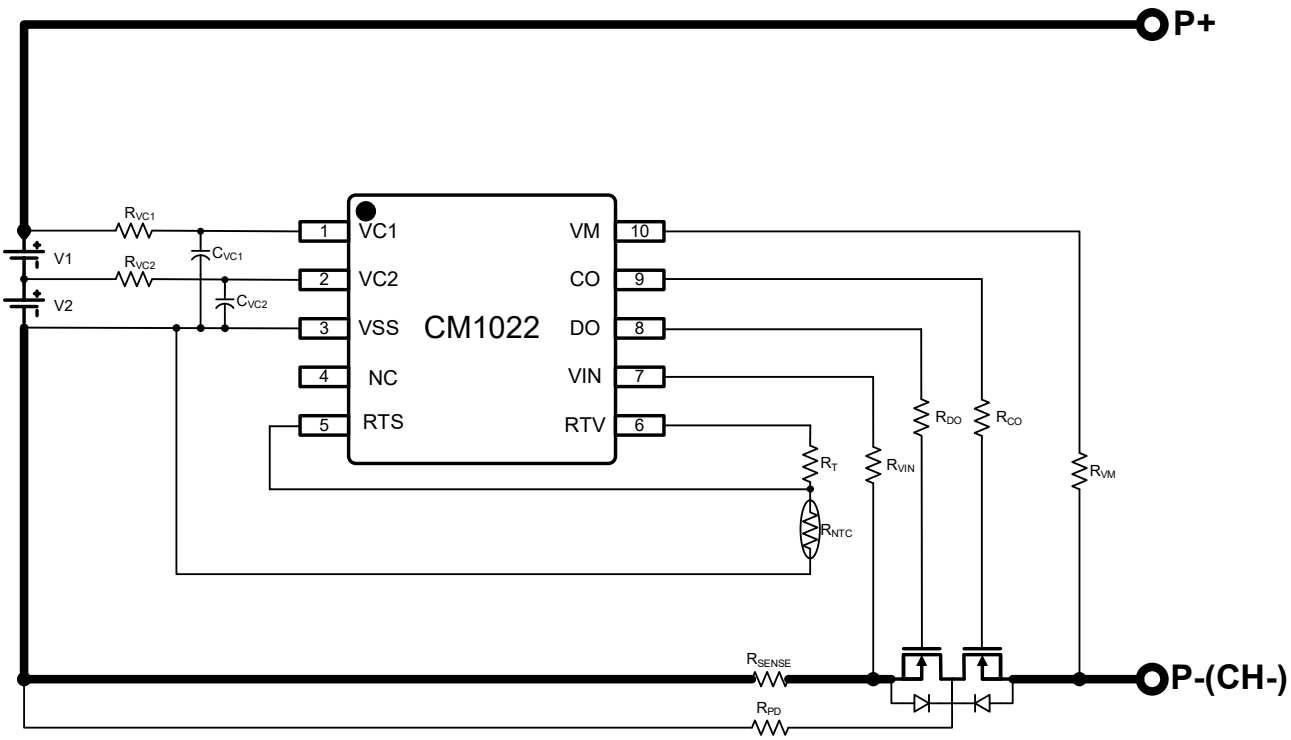


Figure 4 Same port with current-sense resistor solution

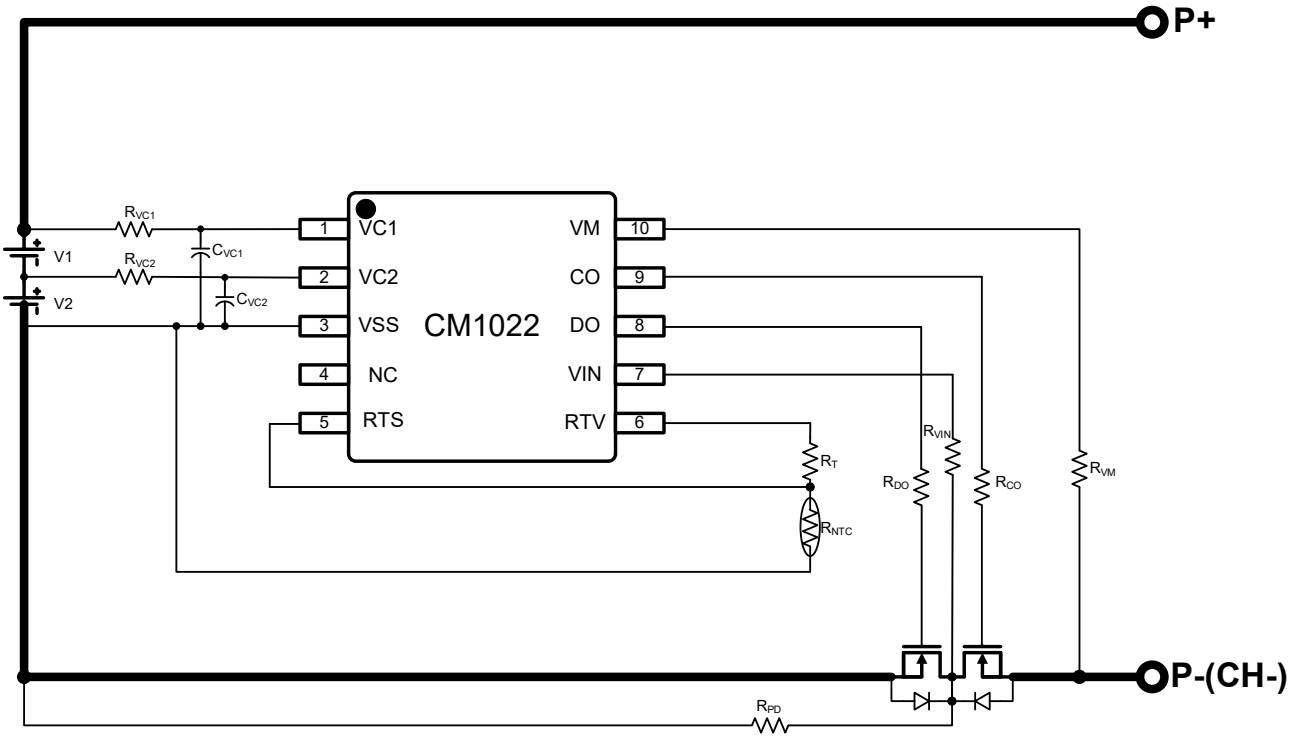


Figure 5 Same port no current-sense resistor solution

2. Charge & discharge circuit separation

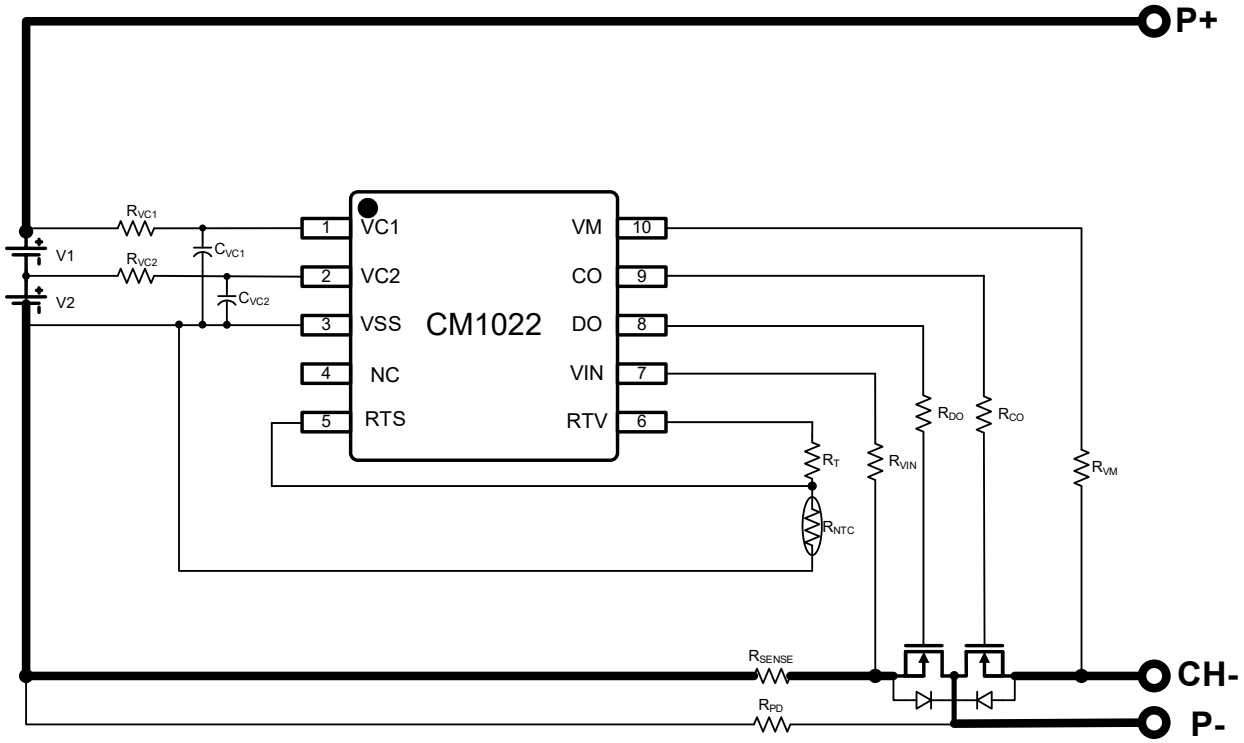


Figure 6 Split port with current-sense resistor solution

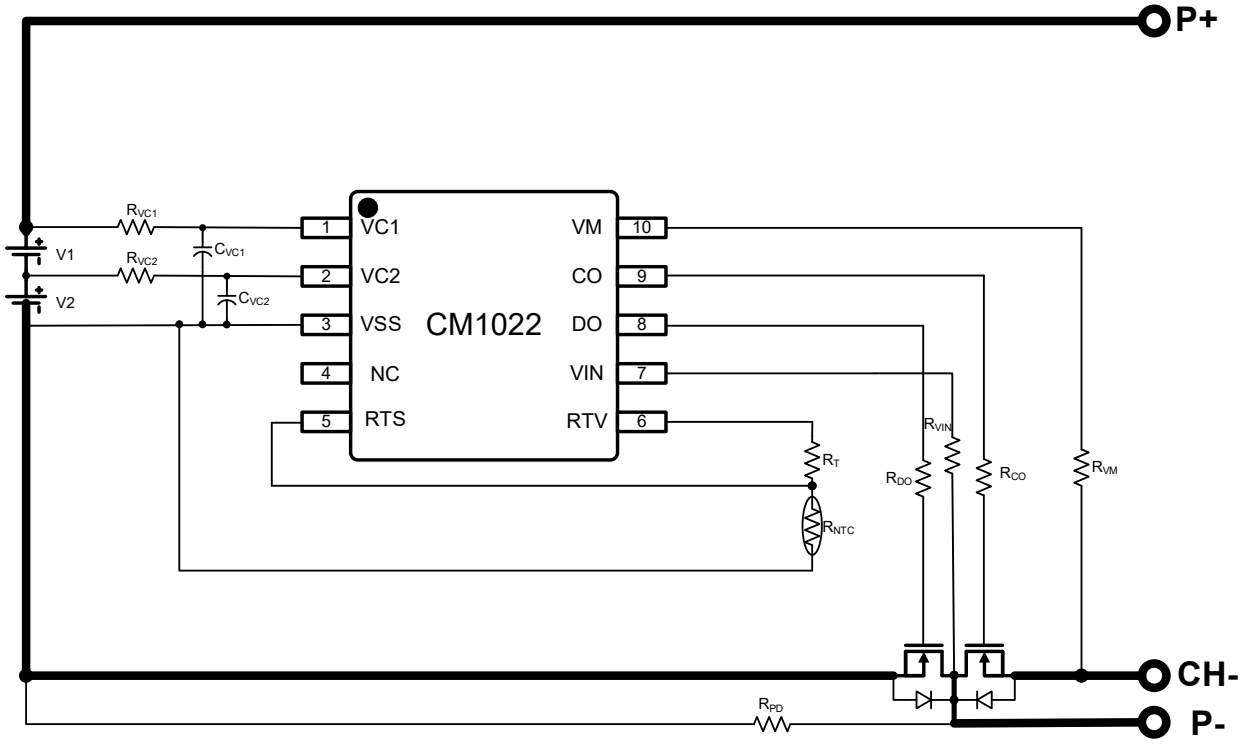


Figure 7 Split-port solution without current-sense resistor

■ BOM list

Device identification	Typ.	Parameter range	Unit
R_{VC1}、R_{VC2}	1	0.9 ~ 1.1	kΩ
R_{NTC}	100 @25°C	–	kΩ
R_T	3*R_{NTC}@T_{CH}	–	kΩ
R_{VIN}（With galvanic）	2	1 ~ 10	kΩ
R_{VIN}（Without galvanic）	330	200 ~ 510	kΩ
R_{VM}	200	150 ~ 250	kΩ
R_{CO}	10	5.1 ~ 15	kΩ
R_{DO}	10	5.1 ~ 15	kΩ
R_{PD}	3	1 ~ 4	MΩ
R_{SENSE}	-	according to the actual overcurrent value	mΩ
C_{VC1}	0.1	0.047 ~ 0.47μF, Withstand voltage≥10V	μF
C_{VC2}	0.01	0.001 ~ 0.1μF, Withstand voltage≥10V	μF

Table 6

Caution:

1. **If it is not in the above two typical applications, please consult our FAE for details.**
2. **Other special application circuits need to modify some of the above-mentioned BOM tables, such as no current-sense resistance scheme, P charging and N discharge scheme, super-high current charging and discharging, etc.**

■ Package

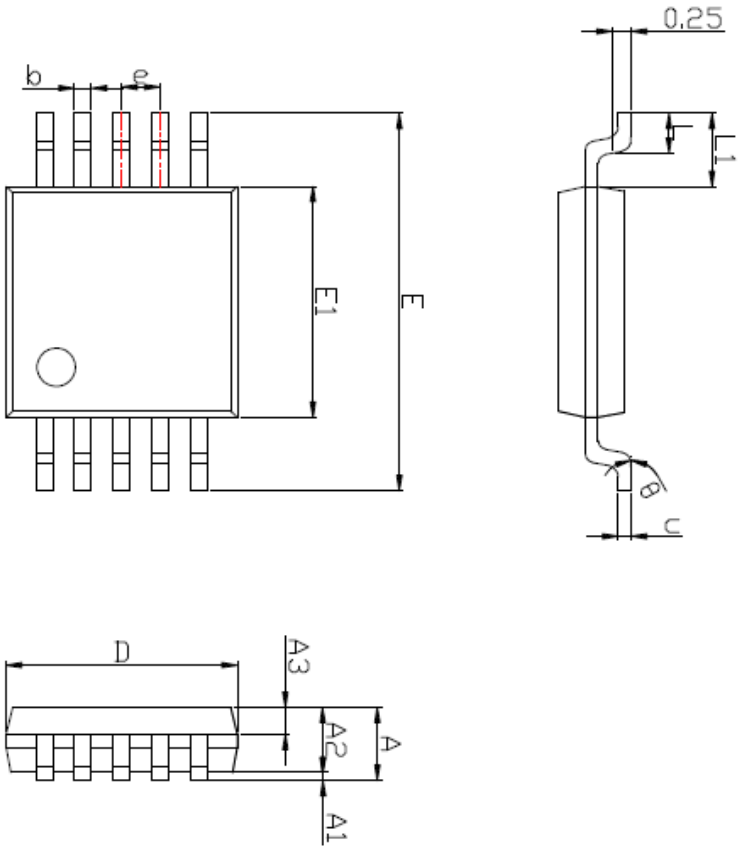


Figure 8

NOTE:ALL DIMENSIONS IN MM

SYMBOL	MIN	NOM	MAX
A	-	-	1.10
A1	0.05	0.10	0.15
A2	0.80	0.85	0.90
A3	0.30	0.35	0.40
b	0.17	0.20	0.23
c	0.13	0.15	0.17
D	2.80	3.00	3.20
E	4.70	4.90	5.10
E1	2.80	3.00	3.20
e	0.50 BSC		
L	0.40	0.55	0.70
L1	0.90	0.95	1.00
θ	0°	-	8°

Table 7

■ Carrier Tape information

MSOP10

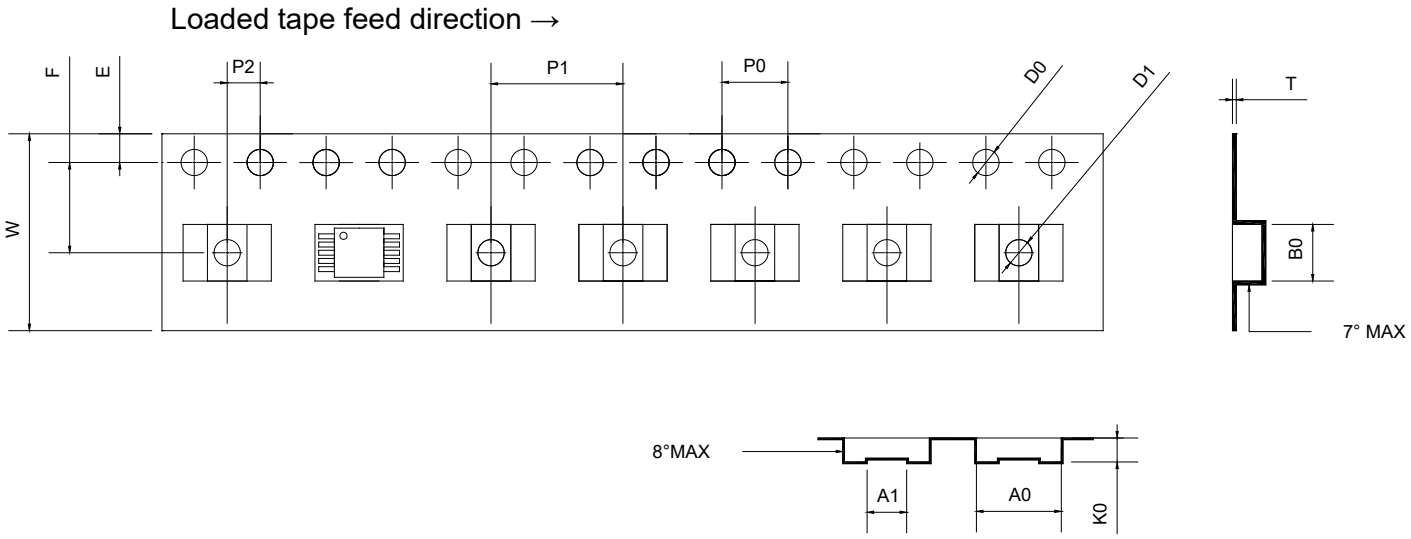


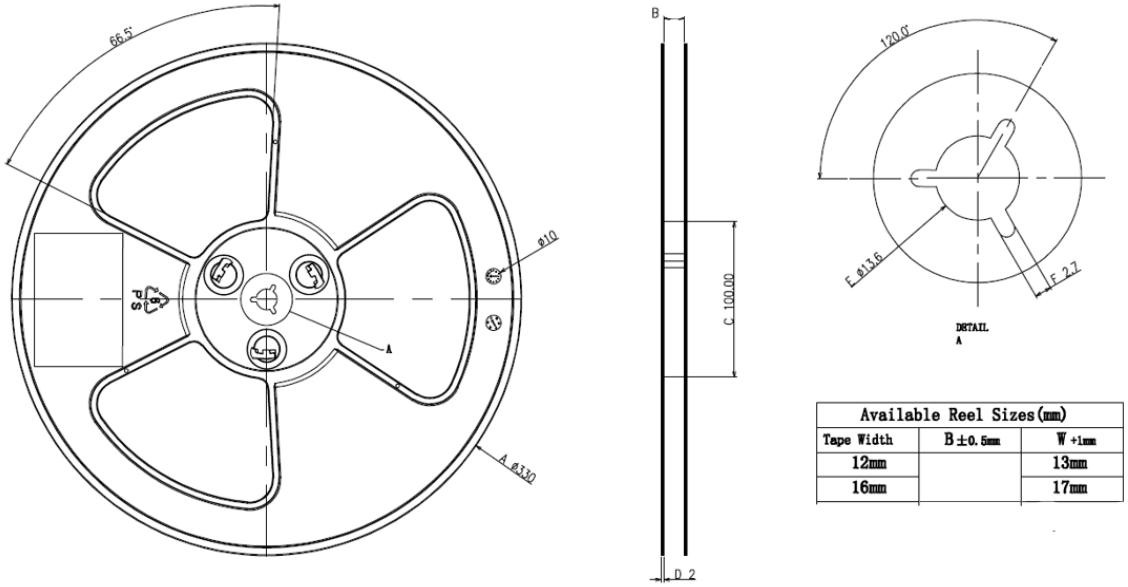
Figure 9

Type	W*P1	Unit
MSOP10	12.0*8.0	mm
Item	**Specification**	**Tol（+/-）**
W	12.00	+0.30/-0.10
F	5.50	±0.05
E	1.75	±0.10
P2	2.00	±0.10
P1	8.00	±0.10
P0	4.00	±0.10
P0*10	40.00	±0.20
D0	1.50	+0.10/-0
D1	1.50	+0.25/-0
T	0.20	±0.05
B0	3.40	±0.10
A1	2.60	±0.10
A0	5.33	±0.10
K0	1.53	±0.10

Table 8

■ Reel information

MSOP10



Available Reel Sizes(mm)		
Tape Width	B ±0.5mm	W +1mm
12mm		13mm
16mm		17mm

Figure 10

■ Package information

Reel	PCS/Reel	Reel /Inner Box	Inner Box/Carton
13”×12mm	4000	2	8

Precautions for use

1. The content in this manual may be changed without notice as the product improves. For more detailed content, please contact our company's marketing department.
2. The circuit examples, usage methods, etc. in this specification are for reference only, and are not designed to guarantee mass production. The company does not assume any responsibility for problems caused by third-party ownership.
3. When this specification is used alone, our company guarantees that its performance, typical applications and functions meet the conditions in the specification. When using the customer's products or equipment, we do not guarantee the above conditions, we recommend that customers do adequate evaluation and testing.
4. Please pay attention to the use of the product within the conditions stated in the specification. Please pay special attention to the use conditions of input voltage, output voltage, and load current so that the power dissipation in the IC does not exceed the power dissipation of the package. The company will not be liable for any losses caused by customers using the product beyond the rated value specified in the specification, even if it is used instantaneously.
5. When using this product, please confirm the laws and regulations of the country, region and purpose of use, and test the ability and safety performance of the product.
6. The products in this specification, without written permission, cannot be used in high-reliability circuits of equipment or devices that may cause damage to the human body, life and property, such as: medical equipment, disaster prevention equipment, vehicle equipment, and vehicle Equipment, aviation equipment, space equipment, nuclear energy equipment, etc., shall not be used as their parts.
7. The company does not assume any responsibility for damages caused by using the products described in this specification for purposes other than those specified by the company.
8. The company has been committed to improving the quality and reliability of products, but all semiconductor products have a certain probability of failure.
9. In order to prevent personal accidents, fire accidents, social damages, etc. caused by the probabilistic failure of this product, customers are requested to fully evaluate the entire system and be responsible for redundant design, measures to prevent fire spread, and safety design to prevent mishandling, you can avoid accidents.
10. This product will not affect human health under normal conditions of use, but because it contains chemical substances and heavy metals, please do not put it in your mouth. In addition, the cracked surface of the package and chip may be sharp, so please protect it when touching it with bare hands to avoid injury.
11. When disposing of this product, please abide by the laws and regulations of the country and region of use and dispose of it reasonably.
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